

**D. AMENDMENTS TO THE DRAWINGS**

There are no amendments to the drawings.

### **E. REMARKS**

The present invention is directed to methods for producing structurally reinforced ceramic matrix composites having a preselected pattern of cooling holes and channels therein. The cooling holes and channels are formed by a process comprising stitching of fugitive fiber into a ply of ceramic fiber material in a preselected pattern, infiltrating the ceramic fiber material with a ceramic slurry, consolidating the infiltrated ceramic fiber material, and sintering the infiltrated and consolidated ceramic fiber material leaving at least one hole and at least one channel in place of the fugitive fiber.

#### **Status of the Claims**

Claims 1 - 24 were pending as of the date of the Office Action. Claims 13-24, drawn to an apparatus made by the methods of the present invention, were withdrawn from consideration as a result of a restriction requirement. By this Amendment, Applicant cancels claims 13-24, without prejudice. By this Amendment, claims 3, 5, 6, and 11 are amended. New claims 25-32 are added by this amendment. Thus, claims 1-12 and 25-32 are pending upon entry of this Amendment.

#### **35 U.S.C. 102(b) Rejections**

The Examiner has rejected claims 1-3 and 11 under 35 U.S.C. §102(b) as being unpatentable over U.S. Patent 5,916,510 to Jessen (hereinafter "Jessen"). In particular, the Examiner stated:

Claims 1-3 and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Jessen (US 5,858,513). Jessen discloses a method of making channeled ceramic structures. The method comprise: providing at least one ply of ceramic fiber material which is deemed as the threading of a ceramic fiber material onto a screen basket (see Jessen's example); the claimed stitching of at least one fugitive thread is deemed as the stitching of the fugitive alternatively on the ceramic fiber ply as noted in Jessen's example; the claimed infiltration of with ceramic slurry is deemed as the immersing the screen basket in a matrix precursor solution of ceramic material noted in Jessen's example; the claimed consolidation is deemed as the drying the infiltration screen basket as noted in Jessen's example; and the claimed sintering is deemed as the heat treatment of the ceramic structure to remove the fugitive fibers and

leaving channels in the ceramic matrix as noted in Col 6, lines 26ff and in figure 3 which shows no damage to the ceramic fiber material.

As for claim 2, the weaved ceramic fibers onto the screen basket forms the claimed ceramic felt or cloth.

As for claim 3, the fugitive thread is a carbon fiber as noted in Col. 5, line 49, or of polymeric composition, which encompasses the claimed nylon, polyester, and rayon polymer fibers.

As for claim 11, the fugitive fibers can have a diameter up to 150 microns, .005 inches, (See col. 3, lines 43-45), hence the formed channel holes would have a corresponding diameter.

Applicants respectfully traverse the rejection of claims 1-3, and 11 under 35 U.S.C. §102(b). Jessen, as understood, is directed to methods of making reinforced ceramic structures by conventional lay-up of ceramic fibers and fugitive fibers, such as in a screen basket by hand. The resulting assembly is lowered into a matrix precursor for a time sufficient to deposit a layer of the matrix precursor on the fibers. The infiltrated assembly is then calcined, and then hot-pressed to harden ceramic precursor matrix, followed by a heat treatment to remove the fugitive fibers, thereby leaving channels in place of the removed fugitive fibers.

Significantly, one or more of the features recited by Applicant in independent claims 1 (as well as new independent claim 25) are not taught or suggested by Jessen, as further described herein. In particular, the cited prior art of Jessen is missing at least one limitation of “providing at least one ply of ceramic fiber material” and of “stitching at least one fugitive thread through the at least one ply of ceramic fiber material in at least one preselected pattern.” Emphasis added. The Examiner’s conclusory statement that “the claimed stitching of at least one fugitive thread is deemed as the stitching of the fugitive alternatively on the ceramic fiber ply as noted in Jessen’s example” is unsupported by Jessen. Jessen has absolutely no teaching or suggestion of a ply of ceramic fiber material, and furthermore has no teaching or suggestion of stitching a fugitive thread through such a ply, let alone stitching a preselected pattern. If the Examiner maintains this objection, Applicant requires that the Examiner provide a more particular reference to Jessen that teaches stitching of the fugitive fibers into a ceramic ply.

More particularly, Jessen does not motivate, teach, or suggest the claimed method of providing a ply of ceramic fiber material and stitching a fugitive thread through the provided ply. Rather, Jessen only refers to ceramic reinforcing fibers and fugitive fibers as “tow bundle” arrangements:

- 11 -

“individual fibers can be many meters long arranged in tows which contain a varying number of fibers. Tows of 500 fibers and 6000 fibers, and others, are known and fibers in a tow are held together by natural forces without resort to any additional material or devicee. Fibers are arranged in tows for practical reasons, such as to facilitate handling thereof. An organic sizing can be used to bind fibers in a tow.” Jessen at Col.3, lines 55-61.

As best understood, the “tow bundle” described by Jessen is a rope-like structure of individual fibers that may also include sizing to allow handling without damaging the individual fibers. By contrast, a “ply” as claimed by Applicant and described in Applicant’s specification includes any sheet ceramic fiber reinforcing element such as “ceramic paper (thin sheets of non-oriented fibers), ceramic felts (thick sheets of non-oriented fibers, much like house insulation) and ceramic cloth (woven fibers), ceramic cloth.” Para. 16, lines 5-8. Jessen’s teaching of a tow bundle, and any arrangement of such bundles into a screen basket, does not equate to Applicant’s ply of a sheet ceramic fiber reinforcing element.

Moreover, the Examiner has apparently equated the term “laying up” as used in Jessen as synonymous with Applicant’s claimed term “stitching.” Jessen refers to “laying up” of tow bundle arrangements of ceramic reinforcing and fugitive fibers, consistent with the meaning of the term as used in the art, and as used by Applicant:

“When it is desired to form a ceramic structure, tows of fugitive fibers are laid up typically in a screen basket by hand. . . In arranging the tows of fugitive fibers in a screen basket, the twos are disposed in the basket so that they extend from one end of the basket to the opposite end. If it is desired to reinforce the ceramic structure and/or have channels of different diameters therein, reinforcing and/or fugitive fibers of different diameters can be included in the lay-up and positioning of reinforcing and/or the fugitive fibers can be varied in a controlled fashion.” Jessen at Col. 4, lines 14-28.

The laying up of fibers by hand as described in Jessen above is consistent with Applicant’s use of the term. Jessen’s description is also consistent with the use of the term in by those skilled in the art of forming reinforced ceramic composite materials, as further described below. However, the above teaching of Jessen does not teach or suggest stitching of the fugitive fibers into the ceramic reinforcing element.

The Examiner's failure to distinguish "laying up" from "stitching" is inconsistent with Applicant's use of the term, as further elicited in Applicant's specification. Applicant specifically describes "sewing or stitching a fugitive thread into a single or laid up plies of previously prepregged ceramic paper, ceramic felts, and/or ceramic cloth, followed by laminating and sintering" at Para 16, lines 10-12. Applicant's use of "laid up" is consistent with conventional stacking of plies of ceramic reinforcing material, and is clearly differentiated from the additional inventive step of stitching such laid up plies together.

Given the consistent use of the term "lay-up" in Jessen and in Applicant's specification, the Examiner's equating of the term "lay-up" to anticipate "stitching" is unsupported by Jessen. Additionally, it is respectfully proffered that the Examiner's interpretation of these two terms as synonymous is heretofore unprecedented, and is contrary to any reasonable interpretation of the terms "stitching" and "laying up" as used and understood by those skilled in the art.

Jessen does not teach or suggest all of the limitations recited in independent claim 1, and particularly does not teach or suggest the use of a ply of ceramic reinforcing material and the stitching of such a ply using fugitive thread in a predetermined pattern. Therefore, Applicant respectfully submits that Jessen does not anticipate Applicant's invention as recited in independent claim 1. With respect to the dependent claims 2, 3 and 11, since the limitations of claim 1 are not anticipated by Jessen, the further limitations of claims those claims are not taught or motivated by Jessen's teachings.

Lastly, without conceding any of the above arguments, Applicant has amended claims 3, 5, 6, and 11 to more clearly and precisely define Applicant's invention. Applicant believes that the amendments to claims 3, 5, 6, and 11 hereunder make the Examiner's rejection of claims 1-3 and 11 under Section 102(b) moot. Applicant requests withdrawal of the rejection under 35 U.S.C. § 102, and reconsideration and allowance of claims 1-12.

### **Section 103(a) Rejections**

Claims 3 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jessen (U.S. Patent 5,858,513), presumably in view of knowledge of one skilled in the art. The Examiner has stated:

- 13 -

Jessen discloses the use of carbon fiber in order to be removed, burned off, during a heat treatment to create channels in the silica matrix. While Jessen does not disclose the use of cotton fibers, it would be obvious to a person of ordinary skill in the art at the time the invention was made to have used cotton fibers since they provide channels to the ceramic matrix and are easily burned off, requirements considered by Jessen in selecting polymer and carbon based fibers.

As for claim 12, Jessen notes that the ceramic matrix may have .10% and up to 80% volume of channels, thus it would be obvious to a person of ordinary skill in the art to have expected Jessen's matrix to have the claimed airflow rate.

Applicant submits that the arguments made with respect to the Examiner's rejection under 102(b) are equally applicable here, since claims 3 and 12 depend, indirectly and directly, from claim 1. Jessen does not teach or suggest each and every limitation of claim 1 for the reasons previously stated herein, and therefore claim 1 is believed to be allowable. The Examiner's combination of Jessen and unspecified knowledge of one skilled in the art would not yield applicant's invention as claimed in claims 3 and 12. Claims 3 and 12 are therefore believed to be allowable.

#### **Allowable Subject Matter**

The Examiner indicated that claims 4-10 would be allowable if rewritten to overcome the rejection under 35 U.S.C. §112, 2<sup>nd</sup> paragraph and to include all the limitations of the base claim and any intervening claims. By this amendment, Applicant has amended claim 4 to correct an obvious typographical error in claim 4 ("at east one a ply" changed to "at least one ply") as cited by the examiner. No new matter is added by the amendment to claim 4. Therefore, it is submitted that amended claim 4 is now allowable.

Additionally, Applicant notes that the dependency of claims 5 and 6 have been changed to depend from claim 3, rather than from claim 4. Applicant submits that amended claims 5 and 6 are not anticipated by the cited art for the reasons cited with respect to claims 1-3, and are therefore allowable.

Additionally, Applicant has added new dependent claims 25-32, whose limitations are taught within the original specification and figures. Applicant submits that no new matter results from these newly presented claims, and that no new matter is presented by any claim amendment made herein.

- 14 -

**F. CONCLUSION**

In view of the above, Applicant respectfully requests entry of this amendment, reconsideration of the Application and withdrawal of the outstanding rejections. No new matter is presented in this Amendment. As a result of the amendments and remarks presented herein, Applicant respectfully submits that independent claim 1 is not anticipated by the cited prior art, and is not rendered obvious by the cited prior art. Thus, independent claim 1 and dependent claims 2-12 are not rendered obvious by the cited art. New claims 25-32 are likewise not obvious in light of the cited art.

As the claims are not anticipated by nor rendered obvious in view of the applied art, Applicant requests withdrawal of the outstanding rejections and allowance of claims 1-12 and 25-32. If the Examiner believes that prosecution of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact applicant's attorney at the phone number listed below.

The Commissioner is hereby authorized to charge any additional fees and credit any overpayments to Deposit Account No. 50-1059.

Respectfully submitted,

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